3.7 Hydrology

Introduction

This report details potential hydrologic and water quality responses to the proposed Como Forest Health Project on the Darby Ranger District. The project occurs within Rock, Lick, and Lost Horse Creek 6th-level watersheds, and includes vegetation and roads management.

Summary of Analysis

The activities proposed in this project are highly unlikely to produce more than minor, short-term water resource effects. A coarse-screen assessment suggested only the Lick Creek watershed had enough proposed activity to warrant an in-depth analysis. In Lick Creek, there is a potential for minor sediment contribution at several culverts due to log haul. Mitigation measures (road drainage and surface improvements) implemented at these sites prior to log haul would minimize road use sediment effects and fulfill State requirements for activities in 303(d)-listed watersheds. There are no activities proposed in municipal watersheds or source water protection zones. Alternatives 2, 3, and 4 would not adversely affect water resources due to the site characteristics, operational limitations, design features and mitigation measures. All forest management prescriptions leave fully-stocked stands that will minimize negative water resource effects; no clearcutting is proposed. All practicable means to minimize sediment production are included in the action alternatives, including water resource protection in the planning, design and implementation phases. Implementation of two watershed improvement actions, along with several road BMP upgrades, would reduce sediment in Lick Creek over both short and long-term time frames. All alternatives are consistent with Forest Plan direction, policy, regulation and law concerning water resources.

3.7.1 Overview of Issues Addressed

Project activities have the potential to produce sediment by hauling timber near and across streams on native or aggregate surface roads. A GIS assessment and the Water Erosion Prediction Process (WEPP) model were used to determine potential erosion and sediment production locations and intensity. Both models are useful in comparing potential hydrologic effects of the project's activities with the existing conditions. The project's potential for sediment production is most important in the Lick Creek watershed, which has most of the timber haul activity, and is also on the Montana Department of Environmental Quality (MDEQ) Clean Water Act S303(d) Impaired Waters list for 2014. The potential sediment production from this project is minimal because no haul road segments parallel streams within RHCAs and there is a lack of harvest in Riparian Habitat Conservation Areas (RHCAs). Therefore, sediment production did not drive the development of a specific alternative.

3.7.1.1 303d Listing of Lick Creek

The ID Team discussed whether the 303d listing of Lick Creek as sediment impaired constituted and issue for the Como Forest Health Project. The only potential source of project-related sediment in Lick Creek would be along haul routes since logging and new roads would not occur in the Riparian Habitat Conservation Areas (RHCAs). The alternatives differ very little in log hauling volume, and therefore, water resource effects.

Design features of the alternatives and upgrading the haul roads in the Lick Creek drainage to meet Best Management Practices (BMPs) would minimize sediment delivery to streams. These measures and features are the same in all the action alternatives so there would be no effects differences between the action alternatives. Since there would be no difference in effects between alternatives relative to the 303d listing, the 303d listing is not an issue though it is an important factor considered in the analysis. Alternative 1 (No Action) gives the decision-maker an option without log haul effects.

3.7.2 Existing Condition of the Affected Environment

3.7.2.1 Analysis Area Watersheds - Water Quality, Wetlands, and Riparian Habitats

The watershed analysis area is the same as the Fisheries analysis area (Figure 3.8-4). The Bitterroot River is the connection between these watersheds, and the segment that connects these watersheds was included in the analysis area. Including the Bitterroot River also allows for incorporating the cumulative effects of activities upstream and providing information on the changes that could affect resources in the river downstream of the project area.

Lick Creek Watershed - Water Quality, Wetlands, and Riparian Habitats

Water resources in the analysis area are comprised mainly of Lick Creek, its intermittent and perennial tributaries, and their adjacent riparian areas. Wetlands are limited to beaver ponds, streamside areas and small seeps and springs. While all water resources in the Lick Creek watershed are important, none are considered unique for the area or the Bitterroot River watershed.

Lick Creek is considered a sub-basin of the Darby Section of the Bitterroot River/Burke Gulch composite 6th level watershed (HUC 170102050805, 35,196 acres). This watershed contains contributing area on both sides of the Bitterroot River and is not a "true" watershed (land area from outside the designated watershed contributes water to the point of interest on the Bitterroot River). The US Forest Service (USFS) -managed contributing area for the Lick Creek sub-basin is estimated at 4,734 acres. Lick Creek is a perennial stream originating on the eastern aspect of Koch Mountain and terminating at the Bitterroot River about 5 miles north of Darby. Lick Creek's watershed has an area of approximately 5,467 acres and a mean elevation of 5,056 feet. Elevation ranges from 3,750 feet to about 7,743 feet. Precipitation comes mainly as snow between October and April, with a mean annual precipitation ranging from around 16 inches (water equivalent) at lower elevations to about 42 inches at the upper elevations. Average precipitation across the watershed is estimated at 22-26 inches. About 89% of the watershed is forested, with mainly Lodgepole pine and subalpine fir at higher elevations and Douglas-fir and ponderosa pine at lower elevations.

Lick Creek streamflow follows a typical snowmelt-driven pattern. High flows of approximately 20 to 30 cubic feet per second (cfs) come in May, gradually tapering off to about one cfs in the fall and winter. There are few large rock outcrops in the small basin and most precipitation is delivered slowly, through porous granite soils. Most runoff occurs between April and July, and flow response to summer thunderstorms is generally minimal due to soil characteristics and the mainly forested watershed, both of which absorb or intercept the low annual precipitation amounts. Most streamflow originates in

the higher elevations (6,000 feet and above), as precipitation in the lower sub-basin is too low to create a consistent flow contribution.

Land Uses and Existing Condition

Land uses in the watershed include timber harvest and road building on the Bitterroot National Forest (BNF) and timber harvest, grazing, agriculture, road building and housing development on private lands. Lick Creek was the site of some of the earliest timber harvest on the BNF in 1906 and has been managed primarily for timber production since that time (USDA 1999). Higher road and crossing densities have been related to increases in fine sediment in streams, suggesting a negative impact to fish and aquatic invertebrate habitats. Table 3.7- 1 displays road and road- stream crossing information for the analysis area watersheds. Roads cover about one percent or less of the area in each of the watersheds, suggesting minimal road effects on watershed-scale infiltration, subsurface water interception and flow timing.

Road and road-stream crossings for Lost Horse and Rock Creek are quite low, suggesting low levels of road effects in those watersheds. The Lick Creek subwatershed has greater road and road stream crossing densities, which suggests an increased risk of water quality issues related to roads. None of these measures exceed 1987 Forest Plan Standards for this watershed or management area, and none suggest high levels of impact to water resources. Potential effects of proposed activities in this watershed can be analyzed by comparing changes in these road system indices.

Table 3.7- 1: Analysis Area Road Miles within 300 feet of Streams and Road Stream Crossings.

6TH LEVEL WATERSHED NAME	SUBWATERSHED AREA (SQ. MI.)	ROADS IN ANALYSIS AREA W/IN 300' OF PERENNIAL STREAMS (MI.)	ROAD CROSSINGS ON PERENNIAL OR INTERMITTENT STREAMS	ROAD STREAM CROSSING DENSITY (#/SQ. MI.)
Rock Creek (170102050805)	55.5	3.23	4	0.1
Lick Creek Sub-watershed (Portion of 170102050807)	7.4	0.88	26	3.5
Lost Horse (170102050601 & SF Lost Horse 170102050602)	72.0	2.06	22	0.5

An active borrow pit at the boundary between S19 and S30, T4N, R21W and its access road (NFSR 5623) is contributing chronic sediment to a tributary of Lick Creek. Surface area is estimated at approximately 0.2 acres and the connecting road at 0.7 acres, for a total connected area of approximately one acre. This was the largest chronic sediment source found during project field work. Two other sources of sediment include the first stream crossing on NFSR 5621 just north of the borrow pit, where an unusual culvert installation is likely causing some stream channel downcutting, and a stream crossing on NFSR5631 near its junction with NFSR 5621. Simple watershed improvements would improve conditions at all three sites.

The 2004 Elk Bed timber sale is the only recent substantial management activity within the Lick Creek 6th-level watershed. Activities were limited to less than 100 acres of upland commercial harvest and approximately 315 acres of non-commercial thinning. The harvest prescription left mature, healthy stands at historic stocking levels and no riparian habitat conservation areas (RHCAs) were affected. No unusual events or results occurred during harvesting or hauling timber, and no negative changes to stream condition were observed during field work for the Como FHP. As predicted in the Elk Bed timber sale analysis, the watershed effects were minor.

The majority of Lick Creek streamside and riparian habitats are well vegetated and in good condition on the National Forest. There is little evidence of grazing impacts until approximately one mile above the National Forest boundary (Table 3.8-3). Riparian and streamside areas had good stability and mostly native vegetation from the headwaters to within about 1 mile of the National Forest boundary, where grazing effects have created noticeable vegetation and channel changes. These changes were mainly riparian forage overutilization and moderate bank trampling, which, if sustained on a yearly basis, will decrease channel stability and increase sediment and nutrient input. Rosgen (1996) channel assessments completed in July 2003 suggest "good" stability for the cobbled, slightly sinuous channel seen in the main stream course. Field visits in 2012 and 2013 suggest no change in channel stability from 2003, with the exception of grazing effects noted above. Riparian areas populated by native species similar to Lick Creek are generally quite resistant to high flows. Large woody debris in the stream is common but below reference conditions due to historic streamside harvest and the old railroad right-of-way clearing. Dispersed camping in riparian areas is limited to the FR5621/Lick Creek crossing, with only one very small site having the potential to produce sediment. The site is compacted but the actual erosion and sediment contribution is minor.

Wildfire has had little effect in the Lick Creek drainage since 1940. Only four fires since this time have been over ¼ acre. The Rock Creek fire burned approximately 200 acres in Lick Creek in 1988, with some areas experiencing very high intensity. About two and a half miles of dozer line was built along the Lick Creek/Rock Creek divide during this fire. This disturbed area was far from running water and has re-vegetated sufficiently to stabilize. The Rock Creek fire and other, older wildfire areas have recovered sufficiently to diminish any negative watershed effects they may have initially caused. Low-intensity prescribed burns have been used in this basin fairly often, especially within the timber harvest areas. The low-elevation ponderosa pine /Douglas -fir (VRU2) vegetation type that dominates the Lick Creek watershed evolved closely with fire, and use of prescribed fire is considered beneficial in this ecosystem.

A 1991 Lick Creek Environmental Assessment proposed, analyzed and later implemented watershed improvement projects including: permanently closing 1.5 miles of road, improving drainage, seeding, and barricading 11 miles of road, improving drainage on 5 miles of open road, closing and rehabilitating 1 mile of heavily impacted ATV trail, adding 20 instream fishery structures in Lick Creek, suctioning sediment in a 1.5 mile reach of Lick Creek, and planting of suitable conifer species in riparian areas to promote future large woody debris recruitment. A 2013 survey determined that the road/stream crossings and ditches are well vegetated and stable on NFSR 5621 and NFSR 5623, the two principle routes through the analysis area. This suggests that the seeding and road drainage improvements are still effectively reducing sediment. While further watershed

improvement projects may be proposed in the future, the watershed condition factors related to roads (Table 3.7- 1) suggests the present road system is reasonable for the level of current and potential future management in Lick Creek. The cumulative road length that is within 300 feet of streams (the greatest Riparian Habitat Conservation Area, or RHCA, width from the Inland Native Fish Strategy (INFISH) Forest Plan Amendment) is displayed in Table 3.7- 1 for all analysis area watersheds.

Streamside riparian areas, upper watershed seeps and the "lick" all contain various types of wetlands. These range from alder/sedge to old-growth forested plant communities. In the riparian areas, availability of large wood for streams varies with the community type, but past logging has somewhat reduced the amount available in the forested areas. Beaver activity has increased wetlands in some areas where stream and vegetation characteristics favor their persistence. The "lick" is a small grass/sedge meadow with soil characteristics that make it attractive to many animals as a mineral source. Vegetation across the "lick" is mainly sedge and grasses, with various shrub species, and is surrounded by aspen and Ponderosa pine forest. The railroad bed built for the initial 1907 timber sale in this watershed encroaches on both the "lick" and Lick Creek streambank riparian areas. While mostly vegetated and stable, subsurface and surface hydrology is still affected by this man-made landform. About 4 miles of this rail line was close to the main creek. Fisheries surveys in 2013 noted one large cut bank that is unstable and possibly related to the rail bed. Overall, riparian areas make up a very small portion of the analysis area, and are more important than usual due to their scarcity. Those with aspen are suffering from fire suppression, and the aspen clones are slowly dying out. Not all riparian areas capable of supplying woody debris to streams are able to do so because of past timber harvest. Promotion of mature forest types in these streamside areas (where appropriate) would increase large woody debris in the future.

Lick Creek 303(d) Impaired Waters and TMDL Status

Water quality in the Lick Creek stream system varies with surrounding land uses and location. The stream is on the MDEQ 2014 303(d) list of Impaired Waterbodies (Montana Clean Water Act Information Center - http://svc.mt.gov/deq/olqs/CWAIC/). Impairment information is provided in Table 3.7- 2, below, and in Project File document Water-005 (Location of the stream) and in Water-007 (MDEQ Assessment Details). Much of this impairment can be attributed to private land management, as the lower assessment site on private land (above Highway 93) has most of the listed sources upstream while the upper site on Forest Lands (just above the NFSR 5621 bridge) does not. The Forest Service portion of Lick Creek is within a livestock grazing allotment but associated effects appear to be limited to the last one to two miles of channel before the National Forest boundary. Silviculture activities in Lick Creek have been minimal over the last 20 years, with only about 100 acres commercially thinned. Additional detail in the 2014 MDEQ 303(d) assessment notes invertebrate communities at the upper assessment site on the National Forest are indicative of high water quality, even though numerical nutrient and sediment parameters were not met (http://svc.mt.gov/deq/olqs/CWAIC/). The 2014 MDEQ 303(d) report also notes metals (aluminum) concentrations surpassing B-1 standards and the mineral "lick" in the lower watershed was noted as the potential source. Forestry activities would not affect metals concentrations and therefore this water quality aspect is not discussed further. More information can be found at the Clean Water Act Information Center (http://svc.mt.gov/deq/olqs/CWAIC/).

Table 3.7- 2: 2014 Montana DEQ 305(b)/303(d) Listing and TMDL Status for Lick Creek

WATERBODY #	STREAM NAME	EST. SIZE (MI.)	BENEFICIAL USES NOT SUPPORTED	PROBABLE CAUSE	PROBABLE SOURCE	TMDL COMPLETED?
MT76H004_170	Lick Creek	6.4	Primary Contact Recreation, Aquatic Life	Alteration in stream-side or littoral vegetative covers	Silviculture activities, Livestock (grazing or feeding operations), Grazing in riparian or shoreline zones	N/A
			Primary Contact Recreation	Chlorophyll-a	Livestock (grazing or feeding operations), Silviculture activities, Natural sources, Source unknown	N/A
			Primary Contact Recreation, Aquatic Life	Total Nitrogen	Natural sources, Livestock (grazing or feeding operations), source unknown, silviculture activities	No
			Primary Contact Recreation	Total Phosphorus	Silviculture activities, natural sources, source unknown, Livestock (grazing or feeding operations)	No
			Aquatic Life	Aluminum	Source unknown	No
			Primary Contact Recreation, Aquatic Life	Sedimentation/Siltation	Grazing in riparian or shoreline zones, Livestock (Grazing or feeding operations), Silviculture activities	Yes

Prior to the 2003 Elk Bed and 2012 and 2013 Como FHP field surveys, Lick Creek was considered to have "low" watershed integrity due to past 303(d) list inclusion. This rating implies that existing watershed condition has been compromised to some extent due to human activities. These ratings are somewhat contradicted by conditions seen in recent field surveys. Stream crossing surveys on the main channel and a selection of tributaries suggest that water quality on the National Forest portion of the watershed is generally

moderate to good and that hydrologically connected disturbed areas (disturbed ground linked to streams by surface flow) are quite limited. Stream channel stability was also rated as "good" using the Pfankuch/Rosgen rating system (Rosgen 1996). Occasional fine sediment infill was observed, but this is expected in a watershed dominated by decomposing granite geology. The percentage of fine particles in the channel was quite low in the upper and middle watershed, but increased near the National Forest boundary where stream gradient flattened out. Surveys from 2013 suggest fine sediment over reference levels in several reaches below NFSR 5621 (Table 3.8-3). Stream banks were often undercut, generally vegetated and stable, providing excellent fish habitat. The fish population is a mix of native cutthroat trout, native non-game species and introduced eastern brook trout, all of which require good water quality to survive. Road crossings and nearby ditches were generally in good condition and well vegetated, and many roads in the watershed are seasonally closed to protect various resources, including water quality. Groundwater interception by road cuts was rare, and limited to several seeps on FR5623 near tributary stream crossings. Factors contributing to minimal groundwater interception include the low annual precipitation, well-drained granitic soils, and minimal road cutting required to maintain roads in this relatively low-angle terrain. Roadsides, ditches, and stream crossings appear to be stable in recent surveys, with several noted exceptions listed as potential watershed improvements. There are no recent ground disturbances within RHCAs except road maintenance at stream crossings and limited grazing effects as noted above.

Overall, surveys suggest watershed integrity ranges between "moderate" and "good" throughout the National Forest reaches. MDEQ invertebrate and National Forest fish population surveys suggest that the upper reach above the NFSR 5621 bridge is supporting MDEQ B-1 standards with the exception of fine sediment over the chosen reference standard. Below NFSR 5621, the lower gradient stream reaches consistently show fine sediment above reference conditions, confirming the partial support of the fishery beneficial use noted in MDEQ 303(d) listing surveys. Needed watershed improvements include reducing the fine sediment contributions from three road-related sites. A general lack of large woody debris lower in the fish-bearing channel reaches was suggested in the 1991 assessment and recent surveys still support this finding. Large woody debris is believed to be less than reference standards due to historic riparian logging prior to current MT Streamside Management Zone (SMZ) and INFISH regulations.

Lost Horse Creek Watershed - Water Quality, Wetlands, and Riparian Habitats

Lost Horse Creek falls within 6th level watershed HUC 170102050601, and joins the Bitterroot River near Darby, Montana. South Lost Horse Creek is considered a separate 6th level watershed (HUC 170102050602) and joins Lost Horse Creek several miles west of the Forest boundary, upstream of the proposed treatment areas and potential haul routes.

Land uses in the Forest Service portion of the main Lost Horse watershed include water storage (dam operations) at Twin Lakes, recreation, road maintenance, timber harvest, and prescribed burning. With the exceptions of dam operations on Twin Lakes and a single road paralleling the stream, most management activities are limited to the lowest portion of the watershed. Private lands downstream include residential development, road building and maintenance, grazing, recreation, prescribed burning, and timber

harvest. The cumulative road length that is within 300 feet of streams (the greatest RHCA, width in the INFISH Forest Plan Amendment) is displayed in Table 3.7- 1.

Land uses in South Lost Horse have been extremely limited by extensive wilderness designation and a large roadless area. Approximately 80 to 90 percent of its contributing area is protected from all uses except non-motorized, wilderness-compatible recreation. The remaining portion has been relatively unmanaged, with no roads and few trails. There are no road/stream crossings in the South Lost Horse watershed. Fish Lake, at the headwaters of this stream, has a wilderness dam and was formerly managed as an irrigation water supply reservoir. It is accessed by foot or horse and stores approximately 350 acre-feet of water.

While land uses in the watershed are varied, negative effects to water quality and stream channel stability have been limited. Both South Lost Horse and Lost Horse Creek have very good water quality and support all state-designated beneficial uses. Neither is listed by MDEQ as water quality impaired. Late summer irrigation demand tends to dry out the main stream below a major diversion and break its connection with the Bitterroot River for several months each year. Streamside camping in the lower 2-3 miles above the National Forest boundary creates bare ground and low-level but consistent sediment sources. The sediment does not build up in the stream channel but is instead transported downstream to the main Bitterroot River. Several boulder barriers have been established to protect stream banks and reduce vehicle disturbance.

Wetlands in this watershed are thin strips adjacent to stream margins, several beaver ponds above the Lost Horse – Como Connector Road (NFSR5621), seeps and springs. Wetland systems are limited in area due to the well-drained, rocky nature of the steep, glaciated terrain.

Rock Creek Watershed - Water Quality, Wetlands, and Riparian Habitats

Rock Creek is considered its own 6th level watershed (HUC 170102050804) which joins the Bitterroot River near Darby, Montana.

Land uses in the Forest Service portion of the main Rock Creek watershed include designated wilderness, substantial water storage at Lake Como with associated dam operations, recreation, road building, timber harvest, and prescribed burning. With the exception of wilderness-compliant recreation, most activities are limited to the lowest portion of the watershed. Private lands downstream include residential development, road building, grazing, recreation, prescribed burning, water development, and timber harvest. The cumulative road length that is within 300 feet of streams (the greatest Riparian Habitat Conservation Area, or RHCA, width from the INFISH Forest Plan Amendment) is displayed in Table 3.7- 1.

Land uses in most of Rock Creek are controlled by wilderness designation. The entire watershed above the Como Lake Reservoir is protected from all uses except non-motorized, wilderness-compatible recreation. There are few road/stream crossings on the Rock Creek main stem below the dam, with most being paved and contributing very little sediment.

While land uses in the watershed are varied, negative effects to water quality and stream channel stability have been limited. Rock Creek above the reservoir has excellent water quality and supports all state-designated beneficial uses. Below the Como Lake Dam,

flows are highly altered and most of the reach between the Bitterroot Irrigation District diversion and the Bitterroot River is dewatered for most of the year. Rock Creek is not on any MDEQ 303(d) list of impaired waters and is considered to fully support all designated uses except for the seasonally dewatered segment.

Wetlands are thin strips adjacent to stream margins, beaver ponds, seeps, and springs. Wetland systems are limited in area due to the well-drained, rocky nature of the steep, glaciated terrain.

3.7.2.2 Watershed Improvement Projects

Due to excellent water quality in Rock Creek and Lost Horse Creeks and a lack of road or management issues in the National Forest portion of these watersheds, there have been no recent watershed improvement projects. Lick Creek had numerous watershed improvement projects implemented in 1991. Several road BMP upgrades, stabilization of a borrow pit and unauthorized OHV route rehabilitation would occur with implementation of any action alternative of the Como Forest Health project.

3.7.2.3 Summary – Existing Condition

Watershed condition varies somewhat across the analysis area. Conditions were quite good at most sites visited on National Forest Lands, but the MDEQ 303(d) status and fisheries surveys indicate a level of sediment and nutrient-related impairment lower in the Lick Creek watershed. Fire suppression and logging over the last hundred years has allowed substantial vegetation changes to take place, making the area more prone to severe fires with brushy second growth stands and few natural fuel breaks. Although several important water quality indicators (invertebrate and presence of cold-water fish) suggest good water quality, the Lick Creek watershed should be considered sensitive due to elevated fine sediment levels in lower reaches and the long history of timber, road and rail operations. Management activities need not be halted altogether but must include this sensitivity during planning. Use of BMPs is considered essential and watershed improvements noted above should be completed as soon as planning and budget allows.

Both Lost Horse watersheds are in good condition on National Forest and display little management influence other than fire suppression and headwaters area dam operations, which affect a small portion of the watershed. Irrigation diversions off-Forest de-water the channel seasonally, which affects fish population connectivity. Cumulative effects are minimal due to protection offered a portion of the watershed by official wilderness status, and the remainder having little timber or road activity. Other than normal consideration for watershed condition (use of BMPs and other standard mitigation), no management restrictions are needed for the analysis area portions within the Lost Horse drainage.

Rock Creek has excellent stream health and is considered a wilderness stream in pristine condition until it flows into Lake Como reservoir; below this point its hydrology, channel and fish habitat is highly modified by water development. Water quality has historically met MDEQ standards below this point, with the exception of consistent dewatering of the stream below the dam by its operations and the BRID diversion. Water temperatures are also higher because of diversion-related flow depletion. Other than normal consideration for watershed condition (use of BMPs and other standard mitigation), no management restrictions are needed for the analysis area segments within the Rock Creek drainage.

3.7.3 Desired Condition and Regulatory Consistency

The desired condition for water resources is stated above in the Regulatory Framework section. The implied goal is to meet all regulatory standards for water quality pertinent to the MDEQ B-1 classification, which applies to perennial streams. Intermittent channels provide seasonal support to the cold water fishery and other aquatic life, mainly through flow contributions to larger channels, and therefore must also be considered.

To comply with Montana law and Forest Service policy, all pertinent BMPs need to be applied to support the MDEQ B-1 water quality standards during forestry operations. These BMPs include planning, design and implementation features to reduce the risk of pollutants such as sediment from entering local streams. The end goal is to prevent sediment-carrying flow originating in areas disturbed by forestry activities (roads and harvest units) from reaching area streams, wetlands or other water bodies.

3.7.3.1 Overview of Relevant Laws, Regulations, and Policies

The Bitterroot National Forest Plan (USDA 1987) provides direction to protect and manage resources. Only direction pertaining to the water resources portion of the project is included here.

The Forest Plan forest-wide goal for soil and water resources is to:

- Maintain soil productivity, water quality, and water quantity (p. II-3).

Forest–wide Management Objectives state how resources will be managed under the Forest Plan:

- Manage riparian areas to prevent adverse effects on channel stability and fish habitat (p. II- 6).

Forest-wide Management Resource Standards provide further detail:

- Utilize equivalent road area or similar concept to evaluate cumulative effects of projects involving significant vegetation removal, prior to including them on implementation schedules. (p. II-23)
- Maintain the percentage of “hydrologically unrecovered” area permitted in a landscape within the guidelines of Table II-5 of the Forest Plan. (p. II-24). This table applies to regeneration harvests only.
- As part of project planning, site-specific water quality effects will be evaluated and control measures designed to ensure that the project would meet Forest water quality goals; projects that will not meet State water quality standards will be redesigned, rescheduled, or dropped. (p. II-24)
- Soil and water conservation practices will be a part of project design and implementation to ensure soil and water resource protection. (p. II-25)
- Actively reduce sediment from existing roads. Sediment reduction measures to be considered include:
  - Cross-drains into vegetative filter strips away from streams
  - Grass seed, fertilizer, mulch, and netting on cuts and fills
  - Slash filter windrows or straw bales at toe of fill in contributing areas
  - Gravel ditches and road surfaces (p. II-25)

The following Management Areas (MAs) have additional Management Goals and Standards that pertain to water resources. (Forest-wide Goals and Standards, and Federal regulations apply to all MAs.)

MA 3b: Additional Management Area Goals:

- Manage riparian areas to maintain flora, fauna, water quality, and water-related recreation activities. Emphasize water and soil protection. Road building in riparian areas will be restricted to meet water quality and fish objectives (pg. III-22).

Management Standards:

- Utilize watershed rehabilitation projects such as stabilizing road cut or fill slope slumps to repair problems (pp. III-6, 12, 18, 27, 33, 59).

Other regulatory or legal requirements that direct watershed management are:

- Section 208 of the 1972 amendments to the Federal Water Pollution Control Act (Public Law 92-500), which specifically mandates identification and control of nonpoint-source pollution resulting from silvicultural activities.
- Clean Water Act, Sections 303, 319, 404
  - Sections 303(d) and 305(b) direct states to list water quality impaired streams (WQLS) and develop total daily maximum loads (TMDLs) to control non-point source pollutants in stream segments not supporting beneficial uses. TMDLs for sediment, nutrients, and temperature were developed for the streams in the analysis area in 2011. The most recent (2014) MDEQ water quality report is used to check beneficial use support of analysis area streams.
  - Section 319 directs states to develop programs to control non-point source pollution, and includes federal funding of assessment, and planning and implementation phases. At this time, no known Section 319 projects would be detrimentally affected by project activities.
  - Section 404 controls the dredge and fill of material in waterbodies of the U.S.; the current proposal for the analysis area does not contain any activities that fall under this regulation.
  - Section 403 of Title IV of the Agricultural Credit Act of 1978 (16 U.S.C. 2201-2205) and Title 7, Code of Federal Regulations, Part 624 (7 CFR 624), the Emergency Watershed Protection Program. The objective of these emergency watershed protection and conservation programs is to assist in relieving imminent hazards to life and property from floods and the products of erosion created by natural disasters that cause a sudden impairment of a watershed.
- ARM 16.20.603 – Best management practices (BMPs) are the foundation of water quality standards for the State of Montana. The Forest Service has agreed to follow BMPs in a Memorandum of Understanding with the State of Montana. Many BMPs are applied directly as design features for this proposal. Implementation and effectiveness monitoring for BMPs is routinely conducted by contract administrators, and during other project implementation and annual monitoring events.

- ARM 17.30 Sub-chapter 6 details water quality standards for the State of Montana. The Forest Service has primary responsibility to maintain these standards on lands under their jurisdiction in the State of Montana.

Designated Beneficial Uses of Local Waters

MDEQ has classified the waters on National Forest that flow through the Como FHP area as B-1 (ARM 16.20.604). The associated beneficial uses of B-1 waters are drinking, culinary and food processing purposes (after conventional treatment); bathing, swimming, and recreation; growth and propagation of salmonid fishes (trout) and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply. Period of flow must be considered when discussing beneficial uses. Intermittent streams will not support all beneficial uses for the entire year.

In Montana, the application of BMPs is the foundation for controlling nonpoint sources of surface water pollution. This is documented in ARM 16.20.603 and means "land and management activities must not generate pollutants in excess of those that are naturally occurring, regardless of the stream's classification". Naturally occurring as defined by ARM, is the water quality condition resulting from runoff or percolation over which man has no control or from developed lands where all 'reasonable' land, soil, and conservation practices (commonly called BMPs) have been applied. Effectiveness of these measures is rated through the State of Montana BMP audit process every other year on a mix of land ownerships where timber harvest has occurred. The results of these audits are published annually by the Department of Natural Resources and Conservation. In 2012, Streamside Management Zone BMP application on Federal lands was rated as 97 percent compliant and 98 percent effective (https://dnrc.mt.gov/Forestry/Assistance/Practices/Documents/2012BMPExecSumm.pdf).

The proposed action has minor potential to affect the physical and biological quality of the waters within the project area. The associated water quality criteria that could be affected are:

- No person may violate the following specific water quality standards for water classified B-1:

  a) The maximum allowable increase above naturally occurring turbidity is 5 nephelometric turbidity units except as permitted in ARM 16.20.633.

  b) A 1 degree Fahrenheit (1˚F) maximum increase above naturally occurring water temperature is allowed within the range of 32 to 66˚F;

  c) No increases are allowed above naturally occurring concentrations of sediment...which are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife (ARM 16.20.633).

3.7.4 Environmental Consequences

3.7.4.1 Methodology

The analysis process consisted of several steps. First, harvest and road use data for the alternatives was reviewed in a "coarse-filter" process to determine which 6th-level watersheds were potentially at risk of water resource effects from proposed activities.

Risk level was estimated by comparing the percentage of watershed proposed to be treated and by the number of stream/road crossings used during timber hauling. The assumption is that potential water resource effects from the project are related to the amount of proposed activities. The purpose of the coarse-filter process is to eliminate areas that have negligible potential for adverse water resource effects from further analysis. Watersheds with potential for measureable adverse effects due to the proposed activities would receive further analysis.

Those watersheds determined to have potential risk for adverse effects were analyzed further by reviewing existing watershed condition and using field, GIS and model results to predict watershed response of the alternatives. Typically, potential water resource effects from timber sales are limited to temperature, water yield and sediment issues. Stream temperature are discussed in the Fisheries Section. Water yield and sediment potential is discussed below.

Vegetation Management and Water Yield Increases

All proposed vegetation treatments are thinning prescriptions, including commercial and non-commercial thinning, and prescribed fire. The proposed vegetation thinning is likely to increase soil moisture within the harvest and burn units by reducing transpiring vegetation. These changes generally benefit remaining vegetation within and adjacent to the treated areas, as lack of soil moisture during the growing season limits growth and vigor in semi-arid settings such as the project area. All proposed thinning prescriptions in the three 6th-level watersheds leave stands of mature trees within historical stocking levels. The remaining forest stand greatly limits water yield increases, because the remaining trees would use much, if not all, of the moisture made available by the thinning treatments. Water temperature, snowpack shading or snowmelt timing are also unlikely to change substantially due to canopy retention in all proposed cutting units and RHCA buffers in units near water features.

Literature reviews by MacDonald and Stednick (2003), Stednick (1996), and Bosch and Hewlett (1982) suggest an equivalent clear-cut area (ECA) of at least 15 - 25% is needed to produce a measureable water yield increase during wet years, depending on several environmental variables. Water yield also varies by type of treatment and by climate. These studies were reviewed and results applied to the proposed project site and activities. For the following reasons, the amount of water yield increase, and therefore the risk of adverse channel adjustments from increased water yield, would be very low:

- Mean annual precipitation on these sites is quite low (15-23") and is unlikely to produce substantial water yield increases. Precipitation in the analysis area is at the low end of the range capable of producing a measureable increase;
- Water yield increases tend to be quickly diluted by fully-forested or non-contributing (low precipitation) zones downstream and upstream. The analysis area watersheds fit this description, with the majority of flow coming from untreated, fully forested areas in the upper watersheds;
- The harvest prescriptions leave substantial mature forest occupying the site. Thinned forest stands in semi-arid climates similar to the project area tend to respond positively to soil moisture increases, utilizing all available water during the hot, dry growing season. This tends to deplete soil moisture, which means

more of the wet season precipitation is used to recharge soils rather than produce surface flow;

- The majority of watershed area for Rock Creek and Lost Horse is either in wilderness or undeveloped status, and the proposal is limited to very small portions of each watershed. With only small proportions of these watersheds affected, the probability of water yield increases in downstream channels diminishes greatly.
- All action alternatives implement a reduction in compacted road surfaces, supporting an expanse of forest cover similar or greater than what currently exists (no short or long-term deforestation is proposed). Roads occupy only a small percentage of watershed area, minimizing water yield effects from this source. Harr et al 1975 report: "Peak flows were increased significantly after road building, but only when roads occupied at least 12% of the watershed. Roads had no detectable effect on volumes of storm hydrographs." Lick Creek, with the highest road density of the three project area watersheds, has only 1% of its area in roads (29.4 miles of road, estimated at 16 foot width for 57 acres in a 4,736 acre watershed). Given the difference in precipitation (Washington Coast Ranges average from 60 to over 100 inches per year) and cumulative road surface between Harr's research areas and the Como FHP project area, it is unlikely the flow regime has been (or will be) affected by cumulative road surface area.
- Almost all thinning activities take place on well-drained granitic soils or moraines, both of which act as sponges to soak up available water and release it over time, reducing potential changes in peak flows.

For the above reasons, water yield increases from proposed treatments are expected to be extremely minor, pose no threat to local or downstream channel stability or beneficial uses and therefore warrant no further analysis or discussion. The cumulative effect of combining the proposed harvest with past and foreseeable future activities is discussed below in the Cumulative Effects section.

Potential Water Resource Effects from Prescribed Fire

Prescribed fire has been used in the recent past at low elevations within the analysis area drainages, and a prescribed burn project has been proposed for the near future. Prescribed fire would be used to treat less than 2,200 acres, mostly within Lick Creek. The low-elevation ponderosa pine/Douglas-fir (VRU1/VRU2) vegetation type that dominates the project area evolved closely with fire, and use of prescribed fire is considered beneficial in this ecosystem. There are no known or recent incidents where a prescribed fire has killed large portions of forest in the analysis area. Therefore, we expect water yield or sediment increases from the proposed prescribed fire would be negligible. Prescribed fires generally benefit watershed condition by thinning forest stands, reducing moisture stress, and increasing vigor of remaining trees and shrubs. Prescribed fire also reduces fuel buildup, decreasing the risk of high intensity fire and associated erosion problems. For these reasons, water resource effects of prescribed fire are considered beneficial and will not be analyzed further.

The indirect effects analysis for the proposed commercial timber harvest, temporary roads, prescribed fire and non-commercial thinning suggest little risk of negative environmental effects when these activities are properly located and implemented. These

specific activities are predicted to add only negligible amounts to indirect or cumulative effects such as management-related water yield or sediment increases in the area of the thinning treatments.

Potential sediment production from road treatments, temporary roads and road use

Field reviews by watershed staff concentrated on road design and condition at stream crossings within the project area. Road surface drainage, grade (slope), and materials were reviewed, along with vegetation characteristics around crossings and below road prisms. All crossings potentially affected by timber sale activity were reviewed. Proposed system and temporary road locations were reviewed both in the field and in GIS. The WEPP model used in analysis is continually updated and is considered state-of-the-art. The expected precision of the model is plus or minus 40 percent, which is typical of sediment models. The model is used to compare alternatives and the outputs are not considered to be absolute predictions of sediment output. Table 3.7- 3 lists the measurement indicator and the sediment risk analysis method. Details and assumptions for the methods are also provided.

Table 3.7- 3: Analysis Methods to Evaluate Effects to Water Resources

POTENTIAL EFFECT	ANALYSIS METHODS
Potential sediment production from treatments and road use	Field & Literature Reviews, Road and Stream map analysis with GIS and the Watershed Erosion Prediction Project (WEPP) (Elliot, et al 2001, 2002) erosion and sedimentation model. The number of stream crossings used for timber haul, and associated sediment production, was compared between action alternatives. Potential activity-related sediment for each alternative is compared to an estimated background level to provide context.

Incomplete and Unavailable Information

There was no incomplete or unavailable information that affected the hydrology assessment of existing conditions or environmental consequences.

3.7.4.2 Spatial and Temporal Context for Effects Analysis – Coarse-Filter

The initial, or coarse-filter, effects analysis area consists of the National Forest portions of Lost Horse, Lick Creek, and Rock Creek 6th-level watersheds, as proposed activities occur within and may affect water quality or beneficial uses within these watersheds. The portion of the Lick Creek-Bitterroot 6th-level watershed on the East side of the Bitterroot River was removed from the assessment as it does not contribute water to any stream within the project area, and would dilute any area-based effects analysis. The duration of the timber sale, road management and watershed improvement activities was estimated at 3-5 years. Due to high recreation use of the project area, the duration of activities is likely to be shortened by timber sale contract clauses, but these have not been established prior to this assessment.

Coarse-Filter Analysis - Results

The watershed, project, and activity areas are displayed in Table 3.7- 4. The analysis area includes all National Forest contributing area for each 6th-level watershed, as defined by the 6th-level watershed boundaries (Figure 3.8-4**.**). Project acres are those within the project boundary, which includes a portion of each listed 6th-level watershed; the

percentage of each watershed within the project area is also listed. The maximum percentage of each 6th level watershed proposed for specific commercial and non-commercial thinning and prescribed ("Rx") fire for the action alternatives is displayed. This represents the actual treatment units within the larger project area boundary, which includes non-activity areas. Lastly, the percentage of each 6th-level watershed that is in designated wilderness status is listed.

Table 3.7- 4: Potential Harvest Effects on Analysis Area Watersheds

SUBWATERSHED (6TH LEVEL WATERSHED NAME & CODE)	FS ACRES WITHIN WATER RESOURCES ANALYSIS AREA	FS ACRES IN PROJECT AREA	6TH-LEVEL WATERSHED WITHIN THE PROJECT AREA (%)	MAXIMUM (%) OF WATERSHED PROPOSED FOR THINNING AND RX FIRE	WATERSHED IN WILDERNESS (%)
Rock Creek (170102050805)	35,564	501	1.4	<1	84
Lick Creek (170102050807)	4,734	3670	77.5	32	0
Lost Horse (170102050601) & SF Lost Horse (170102050602)	64,311	1508	2.3	1	19
Total or Average	104,609	5,679	5.4	3	40

The data displayed above suggests the activities proposed for the alternative with the highest amount of activity would treat one percent or less of either the Rock Creek or combined South Fork and main Lost Horse Creek watersheds. Rock Creek also has a large portion of its watershed protected by wilderness designation, which strictly limits human activities and potential associated effects to water resources. The combined Lost Horse watershed has less area protected by wilderness, but both North and South Fork Lost Horse drainages are currently roadless and have no substantial projects proposed or planned at this time. BMPs, alternative design features and other operational guidelines (Appendix A and Table 2.2-5), would further limit ground disturbance and activities near streams and wetlands. The Lick Creek subwatershed, would have approximately 32 percent of its area treated with vegetation management activities and will be assessed for potential harvest-related sediment effects.

Table 3.7- 5 suggests potential effects of the proposed alternatives would be extremely limited in Rock Creek and Lost Horse watersheds. The only haul route through the Rock Creek watershed (NFSR 5621 and Como Lake Road) crosses no stream channels and one irrigation supply ditch, where it is paved and therefore does not produce sediment. Two perennial and one intermittent stream crossings would be used during timber hauling in the combined Lost Horse watershed. The perennial stream crossings are the NFSR 5621 bridge, which has very flat approaches, a wooden deck and therefore little potential for sediment transport to Lost Horse Creek, and a culvert stream crossing on Moose Creek. The road grade at Moose Creek crossing is very flat and has an improved surface, both of which act to minimize sediment contribution. Map and field inspection shows the distance between NFSR 5621 and Lost Horse Creek increases quickly in the direction of the haul route, further limiting haul-related sediment potential. Lick Creek subwatershed

would have timber haul traffic on 2 perennial and 17 intermittent stream crossings and has a higher potential to contribute sediment to streams.

Table 3.7- 5: Potential Road Crossings Affected by Timber Sale Use, Alternative 2 – Proposed Action

SUBWATERSHED (6TH LEVEL WATERSHED NAME & CODE)	NUMBER OF STREAM/ROAD CROSSINGS ON PROPOSED TIMBER HAUL ROUTES
Rock Creek (170102050805)	0
Lick Creek (170102050807)	Two Perennial, Seventeen Intermittent
Lost Horse (170102050601 & SF Lost Horse 170102050602)	Two Perennial, One Intermittent
Total	Four Perennial, Eighteen Intermittent

Overall, a very small percent of Rock and Lost Horse Creek 6th-level watersheds would be disturbed in any alternative due to small areas proposed for treatment, large roadless and wilderness areas, and large watershed contributing areas. These disturbance levels are very unlikely to drive changes in water quality as treatment areas are very small relative to the watershed size and design features for all action alternatives would minimize adverse effects to water resources. Road crossings in Lost Horse have little sediment risk, and no haul roads cross streams in the Rock Creek drainage. Coarse-filter assessment of harvest and road effects indicates there is little potential for project-related sediment production in the combined Lost Horse (South Fork Lost Horse and Lost Horse 6th-levels) and the 6th-level Rock Creek watersheds and supports eliminating them from more detailed sediment effects analysis. Lick Creek watershed is already listed for sediment impairment and also has a higher risk of sediment production and will therefore be assessed for road use effects.

Spatial and Temporal Context for Detailed Effects Analysis

Based on the information from the coarse-filter analysis, the area for detailed water resource effects analysis was limited to the Lick Creek subwatershed. Lick Creek subwatershed has a high potential for water resource effects from the proposed activities and therefore needs more detailed assessment. The temporal context for detailed effects analysis is the same as for the coarse filter analysis.

Information for the assessment was gathered with field observations, GIS analysis and published MDEQ water quality databases available on the internet. Published scientific literature, Forest Monitoring Reports and other technical documents are referenced to help detail expected water resource response to the proposed activities.

3.7.4.3 Connected Actions, Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

Table 3.8-3 in the Fisheries section provides a list of past, present and foreseeable activities within the effects analysis area that was considered for cumulative effects. Please see discussion of these activities in the cumulative effects discussion for each alternative.

3.7.4.4 Alternative 1 – No Action

This alternative would not implement any management activities, other than to allow the analysis area to continue on its current trends. Current management of campgrounds, roads, trails, and gates would continue.

Direct Effects

There would be no direct effects (e.g., human-caused stream channel disturbance, ground disturbance, or loss of shade) with the No Action Alternative. Any natural disturbance following the implementation of this alternative is considered an indirect effect of choosing it.

Indirect Effects

Under the No Action alternative, ground and forest cover would be maintained similar to the existing condition. Natural disturbances, such as fire or beetles, would periodically thin forest cover if the No Action alternative were implemented. In between these disturbances, forest stands would re-grow or be replaced by new species. These changes, with the exception of high severity wildfire, would have little effect on water resources within the project area due to low annual precipitation and associated low water yields. The likely short-term result (10 to 20 years) of the No-Action Alternative would be conditions similar to those described in the Existing Condition. Over the long-term, as natural disturbances change forest stand density in the project area, soil moisture and streamflow would increase in proportion to the scale and intensity of the disturbance and decrease with forest growth.

The potential for atypical wildfire effects on forest hydrology increases with forest density, especially in forests that evolved under low-severity fire regimes (Agee 2002). Surface erosion, caused by overland flow, is the dominant post-fire landscape response in the northern Rocky Mountains (Wondzell and King 2003), while debris flows and mass wasting are the dominant responses in coastal and interior Northwest regions. Watershed "sponge & filter" functions are often severely degraded in all regions, resulting in heavy sediment delivery to streams, channel adjustments, and higher-than-normal mortality in local aquatic organism populations. For those forest types that typically experience stand-replacement fires (lodgepole pine and some mixed conifer), the high severity fire and associated erosion are part of a natural cycle, although they can negatively affect human values and downstream water uses. There would be a moderate increase in fire-related watershed risk over the long-term (20 years or longer) under the no-action alternative.

Under the No-Action Alternative, the current levels of sedimentation from road use would continue and watershed conditions and water quality would generally remain the same as described in the Affected Environment, unless a wildfire occurred. Other than road surfaces, sediment production rates in the analysis area are currently very low, and would remain low under Alternative 1 until a substantial fire occurs.

Cumulative Effects

The cumulative effects analysis area for water resources includes public and private lands within the Lost Horse Creek, Lick Creek and Rock Creek 6th-level watershed boundaries, as water resources that may be affected by this proposal fall within these boundaries. Activities noted in Table 3.8-3 are considered to have potential to affect water quality, riparian health and beneficial use support. The most likely result of the No-Action alternative is the status quo for water resources, until other projects are developed and

implemented. Other ongoing or proposed activities such as road and trail use, road maintenance, prescribed fire, culvert replacements, timber harvest, and recreation would continue but cumulative effects on water resources would be limited because these projects are or would be designed to minimize watershed impacts.

Site visits in 2003 and 2012 indicate "very good" stream health in all analysis area stream channels (PF-Water-001), with the exception of the lower 2-3 miles of Lick Creek. MDEQ assessment for Lick Creek indicates Total Nitrogen and fine sediment are at levels higher than reference condition, but also documented excellent invertebrate community composition that suggests the biota in the Bitterroot National Forest stream segments above NFSR 5621 are healthy, with raised fine sediment levels found in stream reaches below this point. This stream health condition is likely to continue under the No Action alternative. Stream health conditions in the lower watersheds would also likely remain the same as they are now, unless other activities are proposed to improve them. MDEQ records and assessment suggest both Lost Horse Creek and Rock Creek fully support assigned beneficial uses with the exception of stream dewatering below diversions; National Forest observations support this conclusion.

There would be a moderate increase in fire-related watershed risk over the long-term (20 years or longer) under the no-action alternative. Forest stands within the analysis area would continue to be moisture-stressed, increasing the probability of beetle mortality and fire severity greater than historic norms. Soil erosion and related sediment production after high-severity fires tends to negatively affect stream and riparian health over the short to moderate term (5-7 years). With the exception of these potential fire effects, additions to cumulative effects with this alternative are likely to be negligible, due to the lack of ground disturbance.

3.7.4.5 Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

The No-Action alternative would not "Actively reduce sediment from existing roads" as directed in the Forest Plan. This alternative would not implement watershed improvements to treat known sediment sources noted in the existing condition section. The No-Action alternative would otherwise be compliant with all water quality-related regulation.

3.7.4.6 Other Relevant Mandatory Disclosures

In the short term, sediment contribution from the two eroding sites noted above would continue to affect water quality in a sediment-impaired stream until the watershed improvements were implemented through a different process. The No-Action alternative would not result in any reduction in long-term productivity as fire is considered a natural part of forest processes in the assessment area.

3.7.4.7 Summary of Effects

Summary of the no-action alternative:

No area is proposed for treatment. The no-action alternative would retain present trends of increasing stand density and moisture stress, although there is a high potential for increased beetle kill, which would naturally thin stands and relieve moisture stress. Water yield from the forested portions of the watersheds would vary with natural disturbance

over both the short- and long-term, with relatively less contribution from low elevation areas.

Roads would contribute minor amounts of sediment to streams at several crossings under the no-action alternative. The borrow pit on the dividing line between S19 and S30, T4N, R21W would not be treated in the near future, but could be proposed as a separate project in the future. It would continue as the largest known sediment source in the project area until treated.

Predicting future fire effects is difficult, as fire may be either beneficial or detrimental to watershed health and water quality depending on its characteristics. Implementing the no-action alternative would maintain the current risk of watershed damage from high-intensity wildfire, and increase it over the longer term. Over the next 10-year time span, risk of substantial high intensity fire is estimated at moderate.

Wetlands and floodplains would continue in their current condition and trends. Their potential to be adversely affected by high intensity fire would continue, on an upward trend, if no thinning or fuels reduction operations are completed through this project.

Land use on the private portions of the analysis area watersheds would continue on current trends, along with the associated effects.

3.7.4.8 Effects Common to All Action Alternatives

Certain proposed activities, operational controls, and related effects listed below are common to Alternatives 2, 3 and 4. All planning, design, and implementation activities take place within a framework of operational controls designed to protect water resources. All action alternatives include these protections. Harvest area is also relatively similar between alternatives, and the same main haul roads would be used. These following shared characteristics suggest that water resource effects for the action alternatives would be similar and extremely limited:

- Physical characteristics of treated (thinned) forest stands - All proposed harvest is below 6,500 feet elevation, placing the activity in a low precipitation zone where water yield increases would be negligible. This creates a low risk of excessive water yield increases, channel adjustments, and erosion from the proposed treatments.
- Timber harvest treatment area – The proposed combined commercial harvest and Rx fire treatment area differs by a maximum of 128 acres between alternatives. There are minor differences in the area treated and road-related activity (see separate alternative analysis, below), but watershed and site-level water resource effects related to harvest and prescribed fire area would be similar.
- Physical characteristics of treated (thinned) forest stands - Harvest-related disturbances are generally discontinuous and would be separated from water and wetlands by RHCAs. Maintaining forest and ground cover reduces the risk of erosion, detrimental water yield increases, and sediment or nutrient export.
- INFISH operational restrictions – all proposed treatments are either isolated from water resources by their upland location or INFISH-related stream buffers, or are strictly controlled by design features that specify certain protective limitations. Stream buffers protect streams from sediment and physical damage by maintaining a protective, vegetated filter between the activities and water resources. The INFISH-related design features apply to harvest within the stream buffer strips, where activities must benefit the riparian area and associated habitat.

- Upland or buffered locations - New landings and new specified (permanent) road segments are proposed for upland locations outside of RHCAs and away from water resources. This practice limits new ground disturbance within sediment-contributing distance of streams.
- Soil standards - Soil standards require that 85 percent of area for each harvest unit meet productivity standards before the unit is considered done. Slash and woody debris are required to meet specific volume standards. All of these characteristics enhance water infiltration and sediment filtering efficiency.
- Upland or buffered locations - If temporary roads are included in an alternative, they are located away from water resources, with at least the INFISH buffer width distance between the temporary road and the nearest water resource. Stream buffers protect streams from sediment and physical damage by maintaining a protective, vegetated filter between the activities and water resources.
- Treatment prescriptions – All proposed timber treatments are thinning prescriptions, which leave a forested site sufficiently stocked to use any potential increases in soil moisture. Maintaining forest and ground cover reduces the risk of erosion, detrimental water yield increases, and sediment or nutrient export.
- Log haul sediment mitigation treatments – All action alternatives would implement several important sediment mitigation measures to reduce fine sediment within the Lick Creek watershed. Six road/stream crossings on NFSR 5621 and NFSR 5623 (two of the main haul routes) would receive sediment-reduction treatments consisting of rock-lining ditch segments, aggregate road surfacing through the crossing or new ditch cross-drain culverts. Sites would be treated prior to log haul and multiple treatments may be used at a site (Figure 3.7-1).
- BMPs and Timber Sale Contracts – all action alternatives would utilize legally enforceable contracts to enforce BMPs that minimize effects to soil and water resources. A list of pertinent BMPs is included as Appendix A.
- Activity duration - Timber sale contract duration would be short due to recreation area demands. This short timber sale contract duration would reduce the duration of road and soil disturbances that could affect water resources.
- Log landings, temporary roads, and tracked line machine trails will not be located in the RHCA filter strips (100' for intermittent streams and 300' for perennial streams). Exceptions include areas where existing log landings occur: near the mapped wetland at Unit 45 and NFSR 62966, Unit 39 along NFSR 5608, and Unit 23 on NFSR 62938.

Table 3.7 6 displays estimated soil disturbed area within the Lick Creek 6th-level watershed for each alternative, along with percentage of watershed disturbed. Disturbed area was estimated using the Region 1 soil standard (15% of harvest units) applied to commercial thinning acres. This is based on area with erosion potential and is not the same as the detrimental soil disturbance (DSD) metric used in the soils report. Non-commercial thinning is accomplished mainly with hand labor and no wood product is skidded or cabled out, so no areas of soil disturbance were attributed to these treatments. Prescribed fire was not considered a soil disturbance, as no mechanical equipment is used and units are burned only if soil moisture, fuel moisture, and weather fall within prescribed ranges. Landing disturbance area was estimated by timber staff.

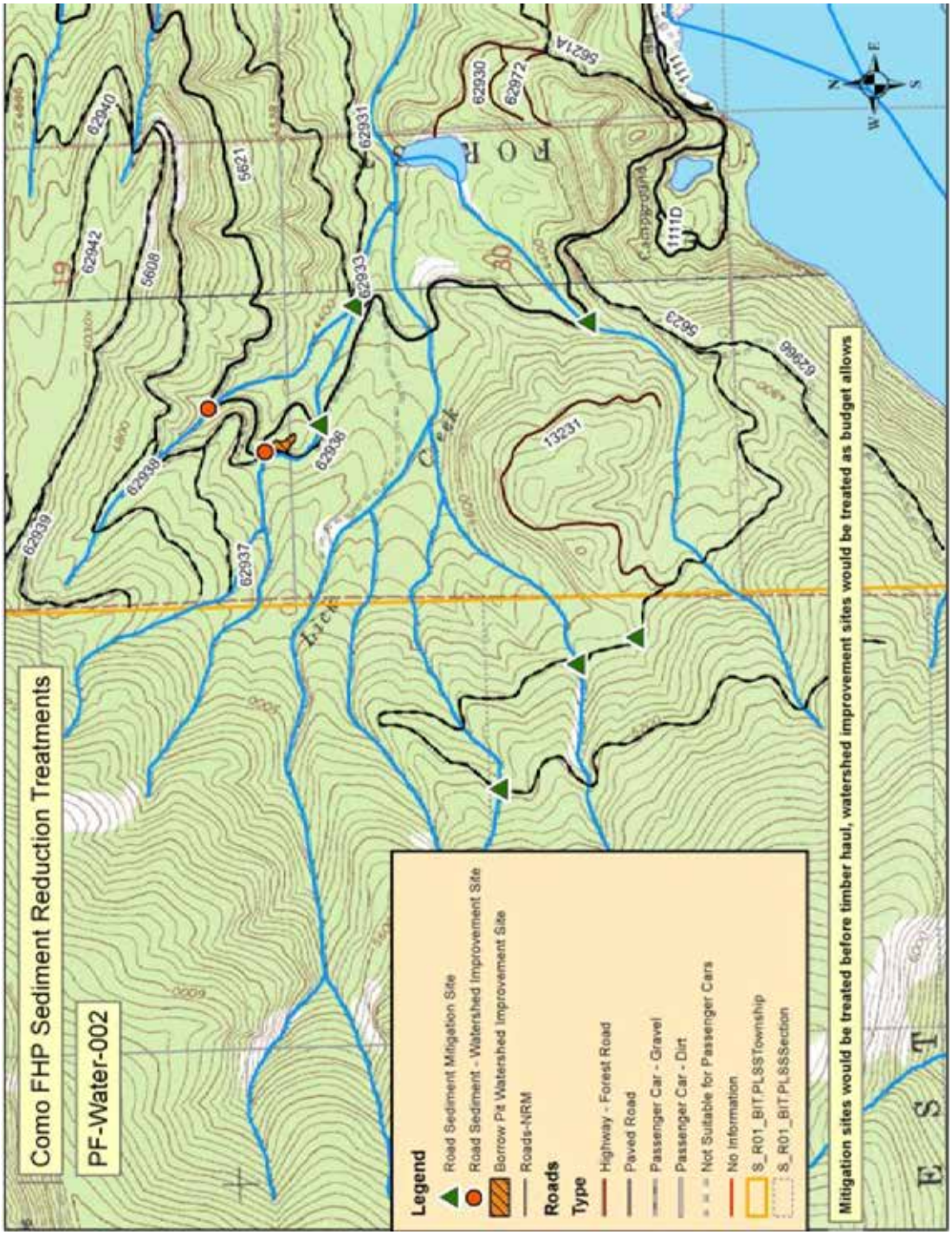

Figure 3.7- 1: Locations of Sediment Reduction Treatments Prior to Log Hauling in the Como Forest Health Project Area.

Table 3.7- 6: Potential Ground Disturbance in Lick Creek Watershed, by Alternative

SOIL DISTURBANCE MECHANISM	ALT. 2	ALT. 3	ALT. 4
Commercial Treatment (acres)	1045	1020	956
soil disturbance in Commercial units (acres)	157	153	143
Area of Landings (acres)	19	15	15
Area of New Road (acres)	3	0	2
Total area of soil disturbance (acres)	178	168	160
Percent watershed disturbed	**4**	**4**	**3**

The disturbance assessment shown in Table 3.7- 6 suggests soil disturbance (and therefore potential sediment sources) ranges from 3 to 4 percent of the National Forest surface area within Lick Creek watershed (adding existing roads would increase the total disturbed area by about 1 percent, for a total of about 5 percent). With BMPs and design features to protect aquatic resources and fish habitat (Appendix A and Table 2.2-5) and sediment-reducing mitigation measures (Table 2.2-6) and watershed improvements included in all action alternatives, the approximate one percent range in disturbance is not a meaningful difference in potential water resource effects between alternatives. Therefore, the indirect effects for Alternatives 2, 3, and 4 are similar.

Alternative 2 – Proposed Action, Alternative 3, and Alternative 4

All action alternatives share a similar level of activities that could affect water resources (Table 3.7- 6). Alternative 2 has a slightly greater distribution of harvest treatments than the other alternatives and will therefore be analyzed as representative of the maximum potential effects to water resources.

Design Features and Mitigation Measures

Design features intended to protect water resources are common to all action alternatives and are listed above under "Effects Common to All Alternatives" and also detailed in Table 2.2-5. These design features include INFISH-related operational guidelines, sediment-reduction activities and BMPs.

Sediment-reduction activities for the Lick Creek subwatershed included with all alternatives:

- Storage treatment of NFSR 62936 and an adjacent borrow pit to stabilize soils and improve infiltration.
- Replacement of a NFSR 5621 culvert on an intermittent Lick Creek tributary and stabilization of an associated head cut that is producing sediment.
- Rock-lining (6) ditch segments on NFSR 5621, NFSR 5623 and NFSR 5608 to filter road-related sediment.
- Rebuilding and surfacing the intermittent stream crossing on NFSR 6231.
- Rehabilitation and closure of an unauthorized OHV route near the NFSR5 608/NFSR 5621 junction.
- Decommissioning of FR62934 (about 0.7 miles), which has a stream crossing and about 250 feet of road within potential sediment-contributing distance of the stream channel.

BMPs used in this project have included planning, design and operational limitations to reduce sediment potential. Planning BMPs include minimizing the road system to be constructed to support the proposed commercial thinning, limiting proposed new road

work (temporary roads, TLM trails, new specified road and excavated skid trails) to upland locations outside of sediment-contributing distance. Design features include proper road drainage features and appropriate excavation widths and grades. Operational limitations include designating protected stream channels, temporary road and TLM trail locations, and RHCA buffers on timber sale maps and making compliance with protective measures part of timber sale contracts.

MT Department of Natural Resources (DNRC) biannual audits suggest planning, design and implementation BMPs are effective. In 2012, Streamside Management Zone BMP application on Federal lands was rated as 97 percent compliant and 98 percent effective (https://dnrc.mt.gov/Forestry/Assistance/Practices/Documents/2012BMPExecSumm.pdf)

Cost of these measures is included in timber sale bids, and purchasers of National Forest timber are legally bound to implement them or face financial penalties and loss of future bidding rights on other sales.

Direct Effects

Direct effects (e.g., harvesting equipment disturbing a stream channel) are highly unlikely due to the design features, MT SMZ regulations and Forest Plan RHCA operating restrictions, and inclusion of BMPs in design, planning and implementation phases of the project. There is extremely low potential for an equipment operator to violate these restrictions due to increased emphasis on resource protection through education, timber sale administrator oversight, and legal (financial) penalties enforced by the timber sale contract. The proposed new specified road segments do not approach within 100 feet of streams. For these reasons, direct effects are highly unlikely and further discussion is not warranted.

Indirect Effects

Proposed activities in the Lick Creek subwatershed and their potential water resource effects considered:

- Commercial Forest Thinning - Ground disturbance and sediment from commercial thinning on approximately 1,045 or fewer acres.
- Road Treatments, System Changes and Use – approximately 6.5 acres of ground disturbance and potential sediment contribution from an estimated 1,597 feet (0.3 miles) of temporary roads, 6,444 feet (1.2 miles) of tracked line machine trails, 5.3 miles of road storage or decommissioning and up to 19 acres of log landings. Additionally, 19 road/stream crossings would be used during timber haul.

Commercial Forest Thinning

Water resource effects analysis for the Lick Creek subwatershed used the proposed activities for Alternative 2, which includes the largest harvest area and therefore the greatest disturbed area. All operations would occur under the common operational limitations and guidelines noted above (Effects Common to All Action Alternatives, Design Features and Mitigation Measures.) The Chapter 3 Soils section summary suggests that soil disturbance (e.g., displacement, mixing or compaction) in harvest units would be limited due to the high percentage of coarse fragments, the relatively well-drained treatment area soils, and operational limitations, including BMPs. Regional soil guidelines limit detrimental soil disturbance to 15 percent of harvest units, minimizing erosion and related sedimentation. Bitterroot National Forest monitoring results suggest that recent

timber harvest units designed with water resource protection in mind and implemented with BMPs produce few negative watershed effects (Bitterroot National Forest Plan Monitoring and Evaluation Reports - USDA 2001, USDA 2002, USDA 2008, USDA 2009, and PF-Water -003 - BMP reviews 2012 & 2013).

Table 3.7- 6 displays the portion of the Lick Creek watershed that would be commercially treated, along with a worst-case estimate of soil disturbance. Disturbed area was estimated using the maximum allowable disturbance under the Region 1 soil disturbance guideline over the treatment area plus the area predicted to be disturbed with temporary access routes and landings.

The WEPP (Elliott and Foltz 2001) erosion and sedimentation model was used to assess the potential of these disturbances affecting local water resources through sediment delivery. Four harvest units that would be the most likely sites to contribute sediment to either Lick Creek or Lost Horse Creek were analyzed. Results suggest a fifty-year return interval precipitation event on a skid trail would have a 42 to 50 percent probability of creating erosion with a maximum rate of 0.61 tons/acre, but only a 2 percent probability of the eroded soil reaching a stream through the 100 to 300 foot INFISH stream buffer. For harvest areas other than skid trails, the erosion and sedimentation probability were both 2 percent, which is similar to undisturbed forest floor. This suggests there is approximately a 98 percent probability that a fifty-year return interval precipitation event would *not* cause eroded soil in harvest units to enter streams. In other words, due to the RHCA filter strip, there is the same low probability of sediment from harvest units as there is from untreated upland slopes.

For the above reasons, sediment contribution from harvest units, including access routes such as tracked line machine trails or temporary roads, would be unlikely. If they occurred, they would contribute extremely minor amounts of sediment. Sediment contributions from harvest units would be similar to that of undisturbed forest floor during a 50-year return interval rain event. The short timber sale duration would also limit the amount of time bare ground would be exposed and erosion events could occur. For these reasons, the threat of harvest-related water resource effects is considered very low and more detailed analysis is not warranted.

Road Treatments, System Changes and Use

Alternative 2 proposes the greatest amount of road-related activity in the Lick Creek subwatershed, including timber haul, temporary roads, tracked line machine (TLM) trails, excavated skid trails, road decommissioning and road storage, and was therefore selected as a worst-case scenario for water resource effects analysis. All road-related operations would utilize pertinent BMPs (Appendix A), alternative design features and Forest Plan guidance designed to reduce sediment contributions to the practicable minimum.

Road treatments, included above under “Effects Common to All Action Alternatives”, and along with project-related haul road maintenance, are included to reduce the amount of fine sediment to the practical minimum. The existing road system in the Lick Creek sub-watershed avoids lengthy segments that parallel streams and therefore avoids the most common haul route sediment problem. GIS analysis suggests there are only approximately 0.13 miles of road within 100 feet of perennial streams and 2.23 miles of road within 100 feet of intermittent streams. Most of this distance is related to road

crossings, where road drainage is more easily diverted to filter strips or filtered with rock-lined ditches than with parallel road segments.

Road maintenance activities within 100 feet of stream channels in the Lick Creek subwatershed include two culvert replacements (NFSR 5621 just upgrade from the NFSR 5608 junction and NFSR 5631 adjacent to where it joins NFSR 5621). Both are intermittent channels and work would be done outside of flow season to avoid working in moving water. All other applicable BMPs would apply, and further oversight is included with SPA124 permitting with MDEQ. Both sites were selected to reduce sediment input to the channels by redesigning and improving the crossings, and no adverse effects are predicted.

Lick Creek subwatershed road system changes (road decommissioning, storage, new specified road, temporary road and temporary TLM trails) are almost wholly limited to areas outside of sediment contributing distance (100 foot minimum), and therefore do not increase sediment risk to local stream channels. The proposed new specified road segments would not create soil disturbance within 100' of or cross intermittent or perennial channels and therefore are likely to produce negligible sediment. These treatments outside of sediment-contributing distance will therefore not be analyzed in detail for water resource effects.

There are two exceptions. One exception is a proposed treatment for FR62936. Approximately 0.2 miles of road (borrow pit access) within 100 feet of an intermittent stream channel would be closed and lightly ripped or decompacted, water barred, mulched and seeded to stabilize the surface and reduce sediment contributions to Lick Creek. The treatment is designed to increase infiltration, reduce surface flow and allow grasses to stabilize the road surface, thereby benefiting downstream perennial stream reaches. The second exception is the proposed decommissioning treatment for NFSR 62934, which would remove one stream crossing from an intermittent channel and stabilize about 250 feet of road bed within 100 feet of the channel. This work would be done outside of flow season to avoid working in moving water.

If a timber sale alternative is chosen, analysis area roads would be used by varied logging support vehicles and log trucks. The increased traffic associated with timber sales may increase fine sediment production at road/stream crossings by crushing gravels and rutting. GIS analysis suggests there would be 17 intermittent stream crossings and 2 perennial stream crossings used during Alternative 2 timber haul in the Lick Creek subwatershed. Table 3.7- 7 summarizes potential sediment effects from this use.

Background sediment levels were estimated by averaging multiple Idaho Batholith-geology sediment rates (Kirchner 2001) from watersheds with similar geology and climate. Applying the average tons/acre/year figure to Lick Creek produced an annual sediment load estimate of 303 tons/year. Road crossing sediment estimates for both high and low traffic were generated with WEPP: Road (Elliott et al 2001) and compared to the Bitterroot Mainstem Total Maximum Daily Load (TMDL) (MDEQ 2011) as a cross-check. The Lick Creek road system is lower gradient than most of the Bitterroot National Forest roads due to lower-angle terrain, and receives more maintenance due to the popularity of the Como Lake Recreation Area immediately to the south. Pre-haul maintenance performed prior to timber hauling would also reshape the road prism and helps water cross-drain off the road quickly. Design features and mitigation measures listed under (Table 2.2-5, Table 2.2-6) would further reduce road-related sediment. For all of these reasons, estimated sediment

from road crossings was less than 1% of background levels for both existing condition (low to moderate traffic) and timber sale (high traffic).

Table 3.7- 7: Lick Creek Alternative 2 Road Crossing Sediment Estimates

Number of haul road stream crossings in watershed	19
Estimated sediment per crossing – existing recreational use (tons/yr)	0.02
Total sediment load (tons/yr (% of background))	0.38 (<1)
Estimated sediment per crossing – proposed timber sale use (tons/yr)	0.06
Total sediment load (tons/yr (% of background))	1.1 (<1)
Increase due to proposed activities (tons/yr (% of background))	0.8 (<1)

Jordan (2006), in a study of forestry-related sediment effects, concluded that changes in sediment load greater than ten percent of background levels within a given watershed were detectable and "...the sediment input would probably be measurable, and depending on its timing and location, it may have a detrimental impact on water quality for a short time, or on the stream channel at some location." Jordan also comments on sediment changes of one percent of background levels "..., the sediment input is much less than the measurement error of sediment yield. Although it might be observed at the source location (for example, a road washout), it would probably be immeasurable at the watershed outlet." Using these figures, this assessment assumes a sediment change of one percent may produce localized effects observable at or adjacent to source areas. Using this guideline, the sediment changes from Alternative 2 would, at worst, produce observable effects only at the source points. For the proposed activities, this is most likely limited to very short reaches downstream of culvert-type road crossings on intermittent and perennial streams. The most likely effect would be a higher proportion of fine sediment in the channel substrate than in unaffected reaches. The bridges in the analysis area have been determined to be negligible sediment sources due to their design and adjacent flat road segments.

The Memorandum of Understanding (MOU) between the Forest Service and State of Montana (MDEQ 2008) requires the Forest Service to be consistent with state water quality laws. Lick Creek does not fulfill all beneficial uses due, in part, to fine sediment in excess of chosen reference conditions. Due to this status, it is important to improve watershed conditions (i.e., reduce sediment) to the level possible if forest management activities are proposed. To improve consistency with Bitterroot River TMDL (MDEQ 2011) direction, the action alternatives include mitigation measures, design features, and watershed improvement projects listed under "Effects Common to All Action Alternatives".

Cumulative Effects

The cumulative effects analysis area would be the same as for the No Action alternative. Water resource issues considered for cumulative effects were limited to sediment and nutrient increases due to the current Lick Creek MDEQ 2014 303(d) listing for these pollutants (Table 3.7- 2). Treatments proposed in the Lost Horse and Rock Creek watersheds (Table 3.7- 5, Table 3.7- 6) are so minimal and isolated from stream channels that no increase in cumulative effects is predicted for these areas and no further discussion is warranted. The list of past, present and foreseeable activities that could affect water resources is the same as that used under the no-action alternative, which is displayed in Table 3.8-3.

Analysis of indirect effects related to harvest units for the action alternatives suggest minimal probability of project-related sediment leaving the logging sites and entering water features such as streams or wetlands. Multiple harvest units in Lost Horse and Lick Creek analysis-area watersheds were analyzed using current modelling technology and results suggest that, due to RHCA filter strips, BMPs (Appendix A) and design features, the harvest units have the same probability of contributing sediment to streams or wetlands as undisturbed forest. No increase in cumulative effects related to harvest units is predicted for analysis area watersheds and no further discussion of this potential cumulative effects source warranted.

Other on-going and foreseeable future activities in the watersheds include road use, road maintenance, future timber treatments, prescribed fire, culvert and bridge replacements, but cumulative effects to water resources would be limited because these projects are or would be designed to minimize watershed impacts. Road use effects from the proposed logging activities was determined to be the most likely contributor to cumulative effects and is examined in detail above, concluding with a likely scenario of minor, short-term increases in sediment production at road/stream crossings that end with the timber sale activities. Effects were determined to be minor due to mitigation measures, lack of road paralleling stream channels and mostly low-gradient road designs. Effects duration is likely to be the same as the timber sale, estimated at 3-5 years but likely to be shortened due to recreation conflicts. After the timber sale ends, a net reduction from current road sediment levels would be realized from the mitigation measures and watershed improvements that are part of the project.

Recreation use is likely to continue on its current trends, and some minor local watershed effects at trail and road stream crossings are expected. These effects would be limited to small sediment contributions from OHV, road, bike, horse, and foot traffic on routes adjacent to and across streams.

Past activities include timber harvest, road building, maintenance and use, grazing, recreation, and the historic rail line construction. Disturbed areas related to all activities, with the exception of grazing, have revegetated and do not currently produce more than minor sediment. Fine sediments contributed by recent grazing may still occupy low-gradient sites near the Forest boundary (section 3.7.2, page 3.7-4) and overlap in effects with current and proposed activities in the lower reaches of Lick Creek.

Watershed improvements listed under “Effects Common to All Action Alternatives” treat the three largest (and only substantial) sources of sediment found in Lick Creek watershed during fieldwork for the project. These treatments would reduce long-term management-related sediment in the Lick Creek watershed below current levels, reduce the levels of cumulative effects, and improve long-term beneficial use support.

Overall, additions to sediment-related cumulative effects would be extremely limited. This is due to the sediment-reduction mitigation measures and design features, the small amount of area being treated, no new road/stream crossings, the thinning and partial-cut methods proposed and application of BMPs. Forest Plan Monitoring for the Bitterroot National Forest in 2001, 2002, 2008, and 2009 suggests that conservatively designed and mitigated (i.e., using all pertinent BMPs) timber harvest activities generally create no detectable changes in stream channel conditions. Other favorable project characteristics listed under “Effects Common to All Action Alternatives” support the conclusion this

project would have only minimal and short-term additions to cumulative effects that would be negligible at the watershed scale.

Nutrient export: All action alternatives have been designed to protect resources and would be implemented with all applicable road and harvest BMPs by including them in the timber sale contract. BMPs used to control nutrients are identical to those used to control sediment, including standard contract measures developed to reduce disturbance, along with design features such as undisturbed buffer strips. Both approaches minimize nutrient export from harvest units. Harvest design for all action alternatives also relies entirely on thinning treatments, which further reduces nutrient export risk as the remaining stand utilizes nutrients on-site. Controlled studies suggest similar project characteristics have been successful in controlling phosphate and nitrate released through vegetation management such as harvest, thinning, and prescribed fire (Edwards et al. 2010), and therefore only minor effects are expected with the proposed activities. BMPs are generally effective in preventing soil transport off harvest units and phosphates are generally associated with soil particles in forest environments. Low annual precipitation would limit off-site nutrient transport from either decomposing slash or burn piles. Therefore, it is unlikely that the proposed harvest units would affect phosphate levels either in local or downstream waterbodies. Soluble forms of nitrogen are detected in streams more often than phosphates after timber harvest, as BMPs have less effect in controlling them. In a study from the Mica Creek, Idaho experimental watershed, Gravelle et al. (2008) suggests that nitrogen levels increased over background levels after clear-cut harvesting and remained at a slightly elevated level for 3 years post-harvest, after which they began to decline towards pre-harvest levels. The same study found no significant increase in phosphates from timber harvest. Overall, available literature suggests little to no risk of phosphate transport into nearby streams, and moderate risk for minor nitrate increases for up to 3 years after treatments end, with decreasing effect farther downstream from the treatment sites.

3.7.4.9 Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

All Federal, State, and Forest Plan regulations regarding water resources would be met with Alternative 2, as long as pertinent BMPs and watershed improvements are implemented. Proposed culvert replacements on intermittent and perennial stream channels need to be permitted with the MT SPA-124 process to comply with MT State regulation. BMPs associated with this project are listed in Appendix A.

The project is consistent with Montana Impaired Waters (303(d)) programs. **Montana State Code (75-5-703, Annotated 2001) provision 10 c) states that " new or expanded nonpoint source activities affecting a listed water body may commence and continue provided those activities are conducted in accordance with reasonable land, soil, and water conservation practices;"**. This proposal within a water body with a finished TMDL exceeds these requirements and is therefore consistent with State law regarding this situation. Sediment modeling and mitigation measures suggest proposed activities would produce only a minor net change and are not likely to cause further water body degradation from the primary impairment sources of siltation and nutrients. Beneficial uses (detailed in the Affected Environment section) would be protected by the design (ridge-top location and minimal area and intensity of treatments) and protective measures (soil, water, and fish mitigations, BMPs) associated with the proposal.

Watershed improvement projects noted above reduce sediment from the major sources found during field surveys, setting the path for long-term improvements in beneficial use support.

3.7.4.10 Other Relevant Mandatory Disclosures

Activities proposed in Alternatives 2 may produce short-term, minor effects to beneficial use support in very short segments of perennial stream channels by hauling timber over various road/stream crossings. Operational limitations, design features and mitigation measures would limit the duration and intensity of the effects to minor levels. Long-term productivity and beneficial use support would be improved by the watershed improvement projects, which would treat several important erosion sources within the Lick Creek watershed and reduce fine sediments in the long term.

3.7.4.11 Summary of Effects

Alternatives 2, 3, and 4 would not adversely affect water resources due to the site characteristics, operational limitations, design features and mitigation measures. All practicable means to minimize sediment production are part of the alternative, including water resource protection in the planning, design and implementation phases. Implementation of two watershed improvement actions, along with several road BMP upgrades, would reduce sediment in Lick Creek over both short and long-term time frames.